Fall Term 00-1

TELCOM 2310 – Computer Networks

Homework 2
Due Date: 9/27/2000

Problem 1

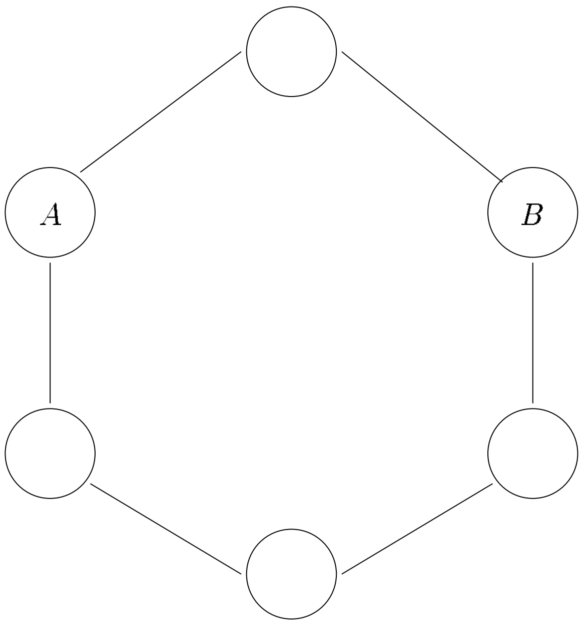

Figure 1: Network Topology.

Consider the ring topology of $N = 6$ nodes depicted in Figure 1. Assume that the links in the network fail independently and with probability $0 \leq p \leq 1$.

1. What is the probability that all nodes can communicate?

2. Generalize the previous question for any N.

3. Assuming that two of the links have failed, what is the probability that nodes A and B, depicted in Figure 1, can communicate?

4. Let D be the minimum distance path from A to B. What are the possible values for D? What is the probability distribution of D?

Problem 2

Suppose that a long message is sent as a sequence of frames f_1, f_2, ..., f_n. The scheme used to send the frames is stop-and-wait. Assume that the time to initiate the transmission of a sequence of framaes is small and the time to process a frame is negligible. The length of an acknowledgment is $\frac{1}{10}$ of the length of the frame. Let:

- T_d be the time to transmit the whole date,
- t_f be the time to transmit a frame,
- t_p be the propagation delay, the time it takes a frame or an acknowledgment to reach the receiver.

1. Compute an expression of T_d as a function of t_f and t_p.

We define efficiency of the line U as the ratio between the time it takes to send the frames (instantaneously) and the time it takes to send the whole data (propagation time and overhead included).

2. Compute an expression of U as a function of $\sigma = \frac{t_p}{t_f}$.

Let B,d,L and V be the baud rate, the length of the link, the length of the frame and the velocity (speed light, $3 \cdot 10^8$ m/s), respectively.

3. Compute an expression of the line efficiency, U, as a function of B,D,L and V.

4. Compute the efficiency of a 10km line, with a baud rate $B = 10$ Mbps and a frame size of 500 bits.

Problem 3

Two nodes are directly connected through a full-duplex communication link of length L. The transmission rate of the link is a R bps. Packets and their acknowledgments are P bits long. Assume that that a Stop-and-Wait protocol is used to control the flow between these two nodes.

1. Assuming no transmission errors, compute the rate of the link, in packets per second.

Assume now that that $K+1$ nodes are connected in series by transmission lines identical to the one described above. In this case also, Stop-and-Wait is used to control the flow between two adjacent nodes and a buffer is used at each connection between the links to store the packets as required.

4. Compute the new transmission rate, in packets per second, through the K links?

Assume now that a packet or its acknowledgment can be corrupted on any given link with a probability, p.

3. Compute the new transmission rate through the K links?

Problem 4

Two nodes A and B use the stop-and-wait protocol for flow control. Acknowledgments are sent as soon as correct packets are received. The processing time is negligible. The transmission time of a a packet is $TRANS_P$, and the transmission time of an acknowledgment is $TRANS_A$. A fraction α of the packets and a fraction β of the ACKs are corrupted by transmission errors.

1. Find the average time, T, needed to send a correct packet from A to B, as a function of $TRANS_P$, $TRANS_A$, α, β, the timeout, *timeout*, and the propagation delay $PROP$.

2. What value of *timeout* would you select both for half and full-duplex links? (Explain why)